

CLAIMS

1. A refrigerant flow section connection structure for use in a refrigeration cycle comprising a channel member having a refrigerant channel communicating with a refrigerant flow section via one end opening thereof, a pipe serving as a refrigerant flow section having a distal end portion fitted into the other end opening of the refrigerant channel of the channel member so as to be connected to the channel member, a fixing member for fixing the pipe to the channel member, and tightening means for joining the channel member and the fixing member together, either the channel member or the fixing member having an engaging portion to engage with a portion of the mating fixing member or the mating channel member so as to prevent detachment of the channel member and the fixing member from each other.

2. A refrigerant flow section connection structure for use in a refrigeration cycle according to claim 1, wherein the tightening means joins together an end portion of the channel member and an end portion of the fixing member; the refrigerant channel is formed in an end portion of the channel member opposite the end portion thereof subjected to joining by the tightening means; and the engaging portion of either the channel member or the fixing member is engaged with the portion of the mating fixing member or the mating channel member at the end portion of the channel member in which the refrigerant channel is formed.

3. A refrigerant flow section connection structure for

use in a refrigeration cycle according to claim 1, wherein the tightening means joins together a longitudinally central portion of the channel member and a longitudinally central portion of the fixing member; the refrigerant channel is formed in each of longitudinally opposite end portions of the channel member; and the engaging portion of either the channel member or the fixing member is engaged with the portion of the mating fixing member or the mating channel member at each of the opposite end portions of the channel member or the fixing member.

4. A refrigerant flow section connection structure for use in a refrigeration cycle according to claim 1, wherein the tightening means comprises a single threaded hole formed in the channel member, and a single bolt inserted through a bolt insertion hole formed in the fixing member and screwed into the threaded hole of the channel member.

5. A refrigerant flow section connection structure for use in a refrigeration cycle according to claim 1, wherein an annular projection is formed on the pipe in the vicinity of a distal end thereof along the entire circumference thereof; a portion of the pipe located distally of the annular projection is fitted into the other end opening of the refrigerant channel of the channel member; a cutout is formed in the fixing member in such a manner as to open at one side of the fixing member, and adapted to be fitted to a portion of the pipe located on a side opposite the portion thereof fitted into the refrigerant channel with respect to the

annular projection; and the pipe whose distal end portion is fitted into the other end opening of the refrigerant channel of the channel member is fitted sideways into the cutout of the fixing member, whereby the engaging portion of either the channel member or the fixing member is engaged with the portion of the mating fixing member or the mating channel member.

6. A refrigerant flow section connection structure for use in a refrigeration cycle according to claim 5, wherein a projecting portion is provided on the end portion of the channel member in which the refrigerant channel is formed, projects toward the fixing member, and extends along an end surface of the fixing member; a groove is formed on a surface of the projecting portion facing the end surface of the fixing member, and extends in a depth direction of the cutout of the fixing member; an outward projecting projection is provided on the end surface of the fixing member and adapted to be fitted into the groove; and a side wall of the groove located on a side toward a projecting end of the projecting portion serves as an engaging portion adapted to engage with the projection.

7. A refrigerant flow section connection structure for use in a refrigeration cycle according to claim 1, wherein a distal end portion of a channel-member-side pipe serving as a refrigerant flow section is fitted into the end opening of the refrigerant channel of the channel member, whereby the channel-member-side pipe is connected to the channel member.

8. A connecting process for a refrigerant flow section in a refrigeration cycle comprising:

preparing a channel member having a refrigerant channel formed in an end portion thereof and communicating with a refrigerant flow section, and a threaded hole formed in the other end portion thereof; a fixing member having a cutout formed at one side thereof and located at an end portion thereof and a bolt insertion hole formed in the other end portion thereof; a pipe having an annular projection formed thereon in the vicinity of a distal end thereof along the entire circumference thereof, a portion of the pipe located distally of the annular projection being adapted to be fitted into the refrigerant channel of the channel member, a portion of the pipe located on the longitudinally inner side of the annular projection being adapted to be fitted into the cutout of the fixing member; and a bolt to be inserted through the bolt insertion hole of the fixing member and to be screwed into the threaded hole of the channel member;

providing a projecting portion on the end portion of the channel member in which the refrigerant channel is formed, in such a manner as to project toward the fixing member and to extend along an end surface of the fixing member; forming a groove on a surface of the projecting portion facing the end surface of the fixing member, the groove extending in a depth direction of the cutout of the fixing member; and providing an outward projecting projection on the end surface of the fixing member, the projection being adapted to be

fitted into the groove;

fitting the portion of the pipe located distally of the annular projection into the refrigerant channel of the channel member;

fitting the fixing member sideways to the pipe, thereby fitting the portion of the pipe located on the longitudinally inner side of the annular projection into the cutout of the fixing member; fitting the projection of the fixing member into the groove of the channel member to thereby engage a side wall of the groove located on a side toward a projecting end of the projecting portion with the projection; and aligning the bolt insertion hole with the threaded hole of the channel member; and

inserting the bolt into the bolt insertion hole of the fixing member and screwing the bolt into the threaded hole of the channel member.

9. A connecting process for a refrigerant flow section in a refrigeration cycle comprising:

preparing a channel member having a refrigerant channel formed in each of opposite end portions thereof and communicating with a refrigerant flow section, and having a threaded hole formed therein between the refrigerant channels, a fixing member having a cutout formed at one side thereof and located at each of opposite end portions thereof, and having a bolt insertion hole formed therein between the cutouts, pipes each having an annular projection formed thereon in the vicinity of a distal end thereof along the

entire circumference thereof, a portion of each of the pipes located distally of the annular projection being adapted to be fitted into the corresponding refrigerant channel of the channel member, a portion of each of the pipes located on the longitudinally inner side of the annular projection being adapted to be fitted into the corresponding cutout of the fixing member, and a bolt to be inserted through the bolt insertion hole of the fixing member and to be screwed into the threaded hole of the channel member;

providing a projecting portion on each of opposite end portions of the channel member in such a manner as to project toward the fixing member and to extend along corresponding opposite end surfaces of the fixing member, forming a groove on a surface of each of the projecting portions facing the corresponding end surface of the fixing member, the grooves extending in a depth direction of the cutouts of the fixing member, and providing an outward projecting projection on each of the end surfaces of the fixing member, the projections being adapted to be fitted into the corresponding grooves;

fitting the portions of the pipes located distally of the annular projections into the corresponding refrigerant channels of the channel member;

fitting the fixing member sideways to the pipes, thereby fitting the portions of the pipes located on the longitudinally inner side of the annular projections into the corresponding cutouts of the fixing member, fitting the

projections of the fixing member into the corresponding grooves of the channel member to thereby engage side walls of the respective grooves located on a side toward projecting ends of the projecting portions with the corresponding projections, and aligning the bolt insertion hole with the threaded hole of the channel member; and

inserting the bolt into the bolt insertion hole of the fixing member and screwing the bolt into the threaded hole of the channel member.

10. A heat exchanger comprising a refrigerant inlet header, a refrigerant outlet header, and a refrigerant circulation path adapted to establish communication between the refrigerant inlet header and the refrigerant outlet header, wherein a pipe is connected to each of the refrigerant inlet and outlet headers by means of a refrigerant flow section connection structure according to claim 1, and the channel member is fixedly attached to each of the refrigerant inlet and outlet headers so as to establish communication between the refrigerant channel thereof and each of the inlet and outlet headers, which are refrigerant flow sections.

11. A refrigerant flow section connection structure for use in a refrigeration cycle comprising two channel members each having a refrigerant channel communicating with a refrigerant flow section, and tightening means for joining the two channel members together, one of the two channel members having an engaging portion to engage with a portion

of the other channel member so as to prevent detachment of the two channel members from each other.

12. A refrigerant flow section connection structure for use in a refrigeration cycle according to claim 11, wherein the tightening means joins together end portions of the two channel members; the mutually communicating refrigerant channels are formed in corresponding end portions of the two channel members opposite the end portions thereof subjected to joining by the tightening means; and the engaging portion of said one channel member is engaged with the portion of said other channel member at the end portions of the channel members in which the respective refrigerant channels are formed.

13. A refrigerant flow section connection structure for use in a refrigeration cycle according to claim 11, wherein the tightening means comprises a single threaded hole formed in said one channel member, and a single bolt inserted through a bolt insertion hole formed in an end portion of said other channel member and screwed into the threaded hole of said one channel member.

14. A refrigerant flow section connection structure for use in a refrigeration cycle according to claim 11, wherein an insertion portion having an inner cylindrical surface is formed at an end portion of the refrigerant channel of said one channel member located on a side toward said other channel member; a male pipe portion having an outer cylindrical surface and adapted to be inserted into the

insertion portion of the refrigerant channel of said one channel member is provided on a surface of said other channel member facing said one channel member and around an opening of the refrigerant channel of said other channel member; and while the male pipe portion of said other channel member is inserted into the insertion portion of the refrigerant channel of said one channel member, said other channel member is rotated about a centerline of the male pipe portion in relation to said one channel member, whereby the engaging portion of said one channel member is engaged with the portion of said other channel member.

15. A refrigerant flow section connection structure for use in a refrigeration cycle according to claim 11, wherein a projecting portion is provided on the end portion of said one channel member in which the refrigerant channel is formed, projects toward said other channel member, and extends along an end surface of said other channel member; a groove is formed on a surface of the projecting portion facing the end surface of said other channel member, and extends in a width direction of the two channel members; an outward projecting projection is provided on the end surface of said other channel member and adapted to be fitted into the groove; and a side wall of the groove located on a side toward a projecting end of the projecting portion serves as an engaging portion adapted to engage with the projection.

16. A refrigerant flow section connection structure for use in a refrigeration cycle according to claim 11, wherein a

distal end portion of a pipe of piping serving as a refrigerant flow section is fitted into an opening of the refrigerant channel of said one channel member located on a side opposite said other channel member, and a distal end portion of a pipe of piping serving as a refrigerant flow section is fitted into an opening of the refrigerant channel of said other channel member located on a side opposite said one channel member, whereby the pipes of piping are connected to the corresponding channel members.

17. A connecting process for a refrigerant flow section in a refrigeration cycle comprising:

preparing a first channel member having a refrigerant channel formed in an end portion thereof and communicating with a refrigerant flow section, and a threaded hole formed in the other end portion thereof; a second channel member having a refrigerant channel formed in an end portion thereof and communicating with a refrigerant flow section, and a bolt insertion hole formed in the other end portion thereof; and a bolt to be inserted through the bolt insertion hole of the second channel member and to be screwed into the threaded hole of the first channel member;

providing a projecting portion on the end portion of the first channel member in which the refrigerant channel is formed, in such a manner as to project toward the second channel member and to extend along an end surface of the second channel member; forming a groove on a surface of the projecting portion facing the end surface of the second

channel member, the groove extending in a width direction of the first and second channel members; and providing an outward projecting projection on the end surface of the second channel member, the projection being adapted to be fitted into the groove;

forming an insertion portion having an inner cylindrical surface at an end portion of the refrigerant channel of the first channel member located on a side toward the second channel member, and providing a male pipe portion having an outer cylindrical surface and adapted to be inserted into the insertion portion of the refrigerant channel of the first channel member, on a surface of the second channel member facing the first channel member and around an opening of the refrigerant channel of the second channel member;

inserting the male pipe portion of the second channel member into the insertion portion of the refrigerant channel of the first channel member in such a manner that the threaded hole of the first channel member and the bolt insertion hole of the second channel member are offset from each other;

rotating the second channel member about a centerline of the male pipe portion in relation to the first channel member, thereby aligning the threaded hole and the bolt insertion hole with each other and fitting the projection into the groove to thereby engage a side wall of the groove located on a side toward a projecting end of the projecting

portion with the projection; and

inserting the bolt into the bolt insertion hole of the second channel member and screwing the bolt into the threaded hole of the first channel member.

18. A connecting process for a refrigerant flow section in a refrigeration cycle comprising:

preparing a first channel member having a refrigerant channel formed in an end portion thereof and communicating with a refrigerant flow section, and a bolt insertion hole formed in the other end portion thereof; a second channel member having a refrigerant channel formed in an end portion thereof and communicating with a refrigerant flow section, and a threaded hole formed in the other end portion thereof; and a bolt to be inserted through the bolt insertion hole of the first channel member and to be screwed into the threaded hole of the second channel member;

providing a projecting portion on the end portion of the first channel member in which the refrigerant channel is formed, in such a manner as to project toward the second channel member and to extend along an end surface of the second channel member; forming a groove on a surface of the projecting portion facing the end surface of the second channel member, the groove extending in a width direction of the first and second channel members; and providing an outward projecting projection on the end surface of the second channel member, the projection being adapted to be fitted into the groove;

forming an insertion portion having an inner cylindrical surface at an end portion of the refrigerant channel of the second channel member located on a side toward the first channel member, and providing a male pipe portion having an outer cylindrical surface and adapted to be inserted into the insertion portion of the refrigerant channel of the second channel member, on a surface of the first channel member facing the second channel member and around an opening of the refrigerant channel of the first channel member;

inserting the male pipe portion of the first channel member into the insertion portion of the refrigerant channel of the second channel member in such a manner that the threaded hole of the second channel member and the bolt insertion hole of the first channel member are offset from each other;

rotating the first channel member about a centerline of the male pipe portion in relation to the second channel member, thereby aligning the threaded hole and the bolt insertion hole with each other and fitting the projection into the groove to thereby engage a side wall of the groove located on a side toward a projecting end of the projecting portion with the projection; and

inserting the bolt into the bolt insertion hole of the first channel member and screwing the bolt into the threaded hole of the second channel member.

19. A heat exchanger comprising a refrigerant inlet

header, a refrigerant outlet header, and a refrigerant circulation path adapted to establish communication between the refrigerant inlet header and the refrigerant outlet header, wherein a pipe serving as a refrigerant flow section is connected to each of the refrigerant inlet and outlet headers by means of a refrigerant flow section connection structure according to claim 11, wherein said one channel member is fixedly attached to each of the refrigerant inlet and outlet headers so as to establish communication between the refrigerant channel thereof and the inlet or outlet header; and a distal end portion of the corresponding pipe is fitted into an end portion of the refrigerant channel of said other channel member located on a side opposite the male pipe portion, and joined to said other channel member.

20. A supercritical refrigeration cycle which comprises a compressor, a gas cooler, an evaporator, a pressure reducing device, and an intermediate heat exchanger for effecting heat exchange between a refrigerant flowing out of the gas cooler and a refrigerant flowing out of the evaporator and wherein a supercritical refrigerant is used, the gas cooler comprising a heat exchanger according to claim 10 or 19.

21. A vehicle having installed therein a supercritical refrigeration cycle according to claim 20 as a vehicle air conditioner.

22. A supercritical refrigeration cycle which comprises a compressor, a gas cooler, an evaporator, a pressure

reducing device, and an intermediate heat exchanger for effecting heat exchange between a refrigerant flowing out of the gas cooler and a refrigerant flowing out of the evaporator and wherein a supercritical refrigerant is used, the evaporator comprising a heat exchanger according to claim 10 or 19.

23. A vehicle having installed therein a supercritical refrigeration cycle according to claim 22 as a vehicle air conditioner.